Wm. Clift Esq.r 9

With the author's sincere regard,

From the Zoological Journal

Art. XV. *On the supposed identity of Whitebait and Shad.* *By* William Yarrell, *Esq.*, *F.L.S.*

That the diminutive fishes called Whitebait are the young of the Shad *(Clupea alosa)* is a point so long considered to be settled, that I fear I shall be thought guilty of a crime little short of treason in Natural History by declaring for an opposite opinion; but having devoted considerable time and attention to this subject during the present season, I shall proceed to detail the facts, historical as well as anatomical, of which this investigation has placed me in possession, and which have led me to adopt a conclusion at variance with all the English authors on this point.

Mr. Pennant in his British Zoology gives the Whitebait a place as an appendage to the Bleak *(Cyprinus alburnus)*, rather, as he remarks, "than form a distinct article of a fish which it is impossible to class "with certainty."

The editor of the edition published in 1812 says, "Mr. Pennant "was either deceived in the specimens sent him as Whitebait, or the "branchiostegous rays were injured, since he counted only three (genus "*Cyprinus)* instead of eight (genus *Clupea)* of these rays, which "number they certainly possess."

Dr. Shaw in his General Zoology follows Pennant, and describes the Whitebait as a species of the Carp or *Cyprinus* genus.

Dr. Turton in his British Fauna, attached to his description of the Bleak, *Cyprinus alburnus*, has the following observation: "The White-" bait which has hitherto been considered as a variety of this fish, ap-" pears by the judicious and accurate investigation of the author of the " Natural History of British Fishes, to be merely the young fry of the " *Clupea alosa* or Shad."

Mr. Donovan, in his Natural History of British Fishes, treats this subject at some length, and considers that his examination affords incontrovertible evidence that the Whitebait is really the fry of the common Shad.

Dr. Fleming, in his recently published History of British Animals, follows Mr. Donovan in considering the Whitebait as the fry of the Shad.

To place this subject, upon which such different opinions have been entertained, in a clear point of view, it may be proper to commence with a short account of the habits of each of these two fishes.

All English writers agree that the Shads enter our rivers in the month of May, for the purpose of depositing their spawn, and, this object accomplished, they return to sea by the end of July. They appear during these three months in the greatest abundance in the Thames, from the first point of land beyond Greenwich, opposite the Isle of Dogs, to the distance of a mile below, and immense quantities are taken every year. Formerly, great quantities of Shads were caught by fishermen at that part of the Thames opposite the present Penitentiary, but the state of the water has driven the fish higher up the stream, and the fishing for them at this point has been almost abandoned.

Very considerable numbers of Shads were also taken in former seasons as high up the river as Hammersmith, but the deterioration which the quality of the water has suffered from various causes, has rendered the fishing for Shads in this part of the river an employment scarcely worth following: the quantity of fishes obtained in a season twenty years ago, compared with the produce of the present year, would be in the proportion of an hundred to one.

By various acts of Parliament,* the conservation of the river Thames from Staines Bridge downwards, and of the waters of the Medway, is vested

* 13 Edward I., c. 47. 17 Richard II., c. 9, and 10 Anne.

in the Lord Mayor and his Court for the time being, who, with the addition of certain other officers, make and enforce the execution of their own bye-laws for the preservation of the fishery. Their 23rd rule and order is as follows: "Shads shall be only taken from the 10th day "of May to the 30th of June in every year."

By making an arrangement both at Putney and Greenwich, I was constantly supplied with Shads twice in every week during the whole, and even somewhat beyond the time they are allowed to be taken; and without going into a detail of weekly observations, it will be sufficient for the purpose to state, that not a single male or female Shad, examined during the months of May or June, had cast its milt or eggs, and this fact it is necessary to bear in mind. Two fishes examined on the 5th of July still retained their roes, but two others subjected to the same test on the 7th had passed their ova.

It is the opinion of the fishermen, who have the best opportunities for observation, that these adult fishes, having performed the office for which they visit the fresh water, take the centre of the current and return to sea. From their weak state, they may be said to drift, rather than swim, with the tide, and, as fishing against the stream is prohibited, they in this way proceed in safety to their destination.

Of the young Shad, when vivification of the deposited ova has taken place, but few examples are caught, and these only by the unlawful mode of fishing for Whitebait. Like the young of Salmon, and the fry of other salt-water fishes, instinct directs the exertion of their first efforts towards gaining the sea. The reason given by the fishermen why these young fishes are not caught in greater quantities, is, that immediately on their acquiring sufficient power of motion, they take the middle of the stream, and make for sea, and as no nets capable of stopping them are used in that part of the river, they escape until their return the next year as adult Shad.

When the preceding winter has been mild, the Whitebait make their appearance early in spring. In the present year, I first observed them in a fishmonger's shop at the West-end of the Town, on Saturday the 29th of March. Knowing the habits of the Shads, and that they did not make their appearance in the Thames till May, it was this early exhibition of Whitebait which induced me to take up, and persevere in, an

investigation, which I have pursued to the present time. I am aware it may be urged, that the periodical visits of fishes as well as other animals are influenced and varied by the temperature of particular seasons and the condition of the animal, but as all the comparative observations I shall make on this subject will be confined to the fish of the same river, and during the same season, this objection will not be valid. Whitebait continued to be procured in the month of April; more abundantly throughout May as the weather became warmer; and with the exception of occasional interruptions to the fishing, from the activity of the Water Bailiff and his deputies, the taverns at Greenwich and Blackwall, as well as several fishmongers in London, have continued to receive a supply up to the present time. The same arrangement that produced me the Shads, produced me also constant supplies of small quantities of Whitebait for weekly examination, and the additional fee which I had promised the fishermen for every young Shad that was preserved for me, produced me, as I have reason to believe, every young fish of that species, as well as any portion I pleased of other fishes, neither Whitebait nor Shads, which the parties I engaged with caught in the pursuit of their avocation. The number of young Shads however did not exceed a score, nor did I obtain one till the end of June, recogniseable instantly from the Whitebait, and both species distinctly known to the fishermen. I may here also add, that no Whitebait are found in other rivers frequented by the Shad; not a single example of Whitebait is ever taken between Putney and Hammersmith, where the Shads deposit their spawn; and although Shads abound in the Severn, which affords this fish in higher perfection than any other river, particularly near Gloucester where immense quantities are taken, the Whitebait are unknown; nor do I ever remember to have seen a notice of the appearance of this fish in any other river in England except the Thames.

But it is not alone on such data as these, however conclusive they may appear, that I rely, for the distinction for which I contend. The best Zoologists of the last fifty years have taught us the value as well as the necessity of searching for, and resorting to anatomical distinctions, as the best foundation for the separation of species, and I shall therefore proceed to detail the various differences that present themselves on a close examination of the external and internal characters of the Whitebait and

Shad, premising, that in every instance I refer to the parts as they appear in a fish of each sort, corresponding exactly in size.

The tongue of the Shad is smooth and dark in colour, the lower jaw has three strong teeth, the whole edge of the upper jaw, which from its shape forms two distinct portions, is also armed with strong teeth, the snout bifid, the eye small.

The tongue in the Whitebait is rough and white, the lower jaw has no teeth on the outer edge, and differs in its form from the same part in the Shad; the upper jaw in the Whitebait possesses teeth on the lower portion only, the snout is not notched, the eye one third larger than that of the Shad, and there is also an appreciable difference in the form of the operculum. Its dorsal line is less curved.

The dorsal fin of the Shad is placed nearer the head than in the Whitebait, and differs also in being less triangular in its form. The ventral fins of both are placed in a line immediately under that of the back. There are also differences in the number of fin rays as the following comparative statement will shew.

Whitebait.

D. 17., P. 15., V. 7., A. 15. Tail 20.

Shad, according to Donovan.

D. 20., P. 19., V., 12., A. 21. Tail 26.

But I place less confidence on these variations in the number of the fin rays, as characters, than on others, not finding them invariably uniform. The body of the Shad is much deeper in proportion to its length than the Whitebait, its prevailing colour on the back, blue, without any very apparent lateral line. The colour of the back of the Whitebait is greenish ash, the lateral line impressed, distinct and straight. The serrations on the abdominal edge also differ in shape, as a reference to the accompanying magnified representations will demonstrate. The form of the stomach is similar in both these fishes, as might be expected from their belonging to the same genus, but the cæcal appendages are much more numerous in the Shad than in the Whitebait. The parietes of the abdomen in the Shad are lined with a delicate silver coloured membrane which also exists in the Whitebait, but in the latter fish this membrane is covered on the side next the viscera with a dark colouring matter resembling the *nigrum pigmentum*, not a vestige of which appears in the Shad.

There is also another difference between the Shad and the Whitebait upon which I place greater reliance, in proof of specific distinction, than on any other single anatomical character. The number of vertebræ in the Shad, of whatever size the specimen may be, is invariably 55; the number in the Whitebait is uniformly 56, and even in a fish of two inches, with the assistance of a lens, this exact number may be distinctly made out.

The value of this character as a specific distinction may be presumed by the following quotation from Dr. Fleming's excellent work on the Philosophy of Zoology, vol. II. page 311.

"The number of the bones of the vertebral column in different species "of fishes, being exceedingly various, suggested to ARTEDI the use of this "character in the separation of nearly allied species. Among the species "of the genus *cyprinus*, for example, a difference in the number of "vertebræ has been observed to the amount of 14. In ascertaining this "character ARTEDI recommends the greatest circumspection. The "fish should be boiled, the fleshy parts separated, and the vertebræ de-"tached from one another, and these counted two or three times in "succession to prevent mistakes. This character is of great use, as it is "not liable to variation, individuals of the same species exhibiting the "same number of vertebræ in all the stages of their growth."

From the observations made by Mr. Donovan in his History of British Fishes, it would be inferred, that the Shads visiting the Thames in the months of May and June, and appearing in immense quantities, heavy in roe, about Greenwich and Blackwall, there deposit their ova, which on vivification become the well known Whitebait. It seems not to be generally known that the Whitebait, though often caught as high up the river as Blackwall, are as frequently taken as low down the river as Erith.

The situation they are found in by the fishermen depends entirely on the state of the water. Always occupying a station which affords a mixture of the water of the sea and river, they are a salt-water fish rather than otherwise, coming upwards with the first part of every flood-tide, swimming always near the surface, avoiding the strong current, preferring the slack water at the sides of the stream that they may not be carried too far up, and returning towards the sea with the first of the ebb-tide.

The net used by the fishermen for the taking of Whitebait is illegal on more accounts than one; the mode of fishing, which is against the stream, is also illegal; the fish float with the tide, and only about two hours of each ebb and flow can be employed to advantage. The fish are most plentiful when the weather is warm, and can only be taken during day light. It would probably be difficult to ascertain the fact, but I have reason to believe that the ova which produce these swarms are deposited in shallow water on the flat shores about and below Gravesend, as I have almost uniformly received the smallest Whitebait from the lower part of the river.

The evidence printed in the report from the commissioners appointed to enquire into the state of the supply of water to this city, contains a sentence in point on this subject, communicated by Mr. Goldham, the clerk of the fish market at Billingsgate, a gentleman who has made fish and fisheries his particular study.

"Whitebait are certainly obtained in greater abundance than formerly, "by poachers (viz. fishermen who have been thrown out of their former "employ) using unlawful nets; it should however be observed, that "Whitebait are taken at particular times of the tide; as they are a "salt-water fish, and come and retire with the water, which is partially "salt; on this account they are never known above Blackwall." See Report, page 72.

From the train of circumstances here detailed, it will be obvious that I consider the Whitebait as distinct from the Shad. I have now before me, preserved in a weak mixture of alcohol and distilled water, both young and old Shads, and nearly one hundred specimens of Whitebait of all sizes, the latter from 1 inch in length to $4\frac{1}{2}$; all taken this season, and all, as I believe, young fish of this year. By this it will be evident that their size has been much under-rated by those authors who have described the length as not exceeding 2 inches. I have also before me a fine specimen of $4\frac{3}{4}$ inches in length, an adult fish with roe, and as the fishing for Whitebait will probably continue till October, I have little doubt of obtaining others in a more advanced state as the season proceeds. I believe that these fishes deposit their spawn during the winter, that the young are slow in their first developement, as well as in their subsequent growth, and probably never attain any considerable size. The food found in their stomachs

most distinguishable, consisted of very minute shrimps.

To shew that my expectations of obtaining other adult specimens of Whitebait with roe as the winter approaches, have some foundation, I quote from Mr. Pennant's editor the following sentence, "the accurate "DUHAMEL asserts that the *Franc Blanquet* (of the identity of which "with the Whitebait we entertain little doubt) is full of eggs and milt "in November and December."

The slow developement of the ova of fishes which spawn in winter may principally be referred to temperature. From the spawn of Salmon, deposited in December and January, the young fry do not come forth till March and April, while the ova of some other species, deposited in the midst of summer, become living fishes on the ninth day.

Believing that the more closely this subject is examined, the more evident the true distinction between the Whitebait and Shad will appear, I venture to propose the term *alba* for the former species, the characters of which have been already noticed in detail, and of which a correct figure by Mr. James Sowerby is annexed. The name given by Mr. Donovan to his Whitebait *(Clupea alosa junior)* may still be retained without inconvenience, since the fishes represented by that gentleman in his 98th plate, are in reality young Shads, and not Whitebait; and I have entered thus fully into the investigation with the hope of clearing up the confusion and errors at present existing on this subject, in most of, if not all, our Zoological works.

Ryder Street, St. James's.
August, 1828.

Description of the Plate.

TAB. V.

Fig. 1. Represents a young Shad.
2. Whitebait.
3. Edge of the mouth of the Shad as seen when magnified.
4. Abdominal serrated edge of the Shad.
5. Edge of the mouth of the Whitebait as seen when magnified.
6. Abdominal serrated edge of the Whitebait.